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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/893,803	06/28/2001	Bharath Rangarajan	F0660	7099

7590 11/02/2005
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EXAMINER

ROSENBERGER, RICHARD A

ART UNIT	PAPER NUMBER
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2877

DATE MAILED: 11/02/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/893,803

Applicant(s)

RANGARAJAN ET AL.

Examiner

Richard A. Rosenberger

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 22 August 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-29 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-28 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

1. An appeal brief was filed on 22 August 2005. A review of the arguments in the appeal brief makes it clear that the cited and applied Moslehi reference is not being understood in the appeal brief. As it is clearly unfair to applicants and to the assignee to send the case to appeal, with the time the appeal process takes, when the arguments are so clearly based upon a misunderstanding of one of the references, the finality of the rejection of 24 March 2005 is withdrawn. A new rejection below is being made in hopes that a new reference can be better understood and thus prosecution may be advanced.

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mozumder et al (US 5,661,669) and Miller et al (US 6,643,557) in view of the acknowledged prior art.

As in claim 1, Mozumder teaches a system in which there is an etching system for processing semiconductor wafers; see, for instance, column 3, lines 12-31 which refers to parameters such as "etch rate (line 22) and etch rate uniformity (lines 22-23). Such a etching process win comprise "one or more etching components". The Mozumder reference teaches an etch component controller (controlling circuit 14 and adjusting circuit 16). The reference has measuring system for measuring at least one process

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parameter; the measuring system “functions to measure one or more actual quality characteristics of the process”, “may comprise any appropriate in-situ sensor that is operable to provide real-time measurement of quality characteristics of a semiconductor fabrication process”, and may comprise “an appropriate critical dimension sensor” (column 4, lines 24-25, 30-33, and 34). There is a process analyzer (comparing circuit 24) coupled to the measuring system (see figure 1) that receives the measured parameters to determine whether adjustments to the etching components are needed to fabricate the features within desired critical dimension tolerances.

Mozumder does not teach any particular measuring device, merely stating that “any appropriate in-situ sensor” may be used. It would have been obvious to use “any appropriate in-situ sensor”, including those which direct light onto the wafer” and make the measurements “based on light reflected from the wafer”, such as known scatterometers (or other such optical measuring devices, such as, for example, an ellipsometer; claim 1 is not limited to scatterometry). Miller et al, for example, teaches using scatterometry to control an etch process, which will comprise “one or more etching components”, see figure 4 in particular, with box 420 (“acquire and analyze scatterometry data”) and boxes 440 and 450 (“perform feedback corrections” and “perform feed-forward corrections”, respectively).

Neither Mozumder nor Miller explicitly teaches using scatterometry to measure “multi-slope features”, although the Miller reference does teach using is to obtain “line shape adjustments” (column 5, lines 19-21 and column 8, lines 13-15). The instant specification presents the necessary scatterometry techniques to practice the invention as being known in the prior art (page 12, lines 12-16: “The scatterometry system 822

employed in the measuring system may be any scatterometry system suitable to carry out the present . . . [s]catterometry systems are well known in the art and therefore further discussion related thereto is limited for sake of brevity.”).

As those in the art, as shown by Miller, knew that scatterometry can be used to control an etch process including “line shape adjustments”, and knew that scatterometry could be used to measure multi-slope features, it would have been obvious to control such multi-slope features using scatterometry in systems such as taught by Mozumder et al and Miller et al.

As shown by Miller, it is known in the art to use scatterometry to measure dimensions on a wafer for process control, and as shown by Mozumder et al it is known that such measurements used for process control can be made *in situ*. It would have been obvious to use the scatterometry for such *in situ* measurements and control because it is known that scatterometry can be used to make measurements that are appropriate for process control, and it is known to make measurements appropriate for process control *in situ*. There is nothing in the art that would suggest to those in the art that scatterometry would cease to work if the object being measured is in a process chamber.

Having the computer to store the measured parameters to have them available for analysis of the process or processing system, or other purposes, would have been obvious.

Similarly for claim 8. Claim 8 calls for “partitioning the wafer into one or more portions”, It is noted that the claim includes one portion, which is not dividing the wafer at all. Further, the claim does not use this “partitioning” in any manner, such as

obtaining different measurements from different portions, controlling the processing separately for each portion, or the like. Similar to claim 8 is claims 12 and 13. As in claim 8, claims 12 calls for, but does not use in any manner, "partitioning the wafer into a plurality of grid blocks", and claim 13 calls for, but does not use, "partitioning the wafer into a plurality of portions. The claims call for no more than etching and measuring "at least one portion of the wafer"; thus any etching or measurement that treats any two sections of the wafer differently, such as etching different structures on different areas of the wafer, will partition the wafer in the manner of the claims.

Claim 14 calls for a data packet containing the information that will be used in a system such as is claimed in claim 1. As set forth above, the system of claim 1 required data to be generated and sent, and such data will comprise a "packet".

As for claim 15, as set forth above relative to claim 1, it would have been obvious to determine a desired profile of a feature on a wafer, etch the device to conform to the profile, detect the actual profile using scatterometry, and to adjust the etching system as necessary to produce the desired multi-slope profile. See in particular the comparing circuitry 24 of Mozumder et al.

As for claim 25 and 29, see the discussion of claim 1 above, which sets forth the rationale for the obvious what is claimed in these claims.

As in claims 2, 9, 10, the known scatterometry systems, including those discussed as known in the prior art, collect reflected light.

As in claim 3, it would have been obvious to use any measurable dimension of recognized importance, including the height, width, slope, etc. of the features. As in

claim 4, this is true even in the known devices in which there are feature angles that are not right angles.

As for claims 5 and 6, see the discussion of claims 8, 12, and 13 above. As there, the partitioning of the wafer into a plurality of grid blocks is claimed as no more than a type of non-limiting “mental step” that is met whenever the etching and measurement is done in a manner in which different areas of the wafer are treated differently, such as, for example, the measurement is made in a manner in which at least a part of the wafer is measured and another part is either not measured or measured separately; this “partitions” the wafer in the manner claimed.

As in claim 7, the use of “scatterometry signatures” is a well-known manner of implementing scatterometry.

As in claims 11, 16, Mozumder teaches comparing the measured parameter with acceptable parameters. In order to compare the measured parameters with the acceptable parameters, it is at least obvious to store the acceptable parameters so the comparing circuit can make the comparison.

As in claims 17-19 and 26-28 the device of Mozumder analyzes the parameters of the etching of the device by comparing them with previously determined acceptable parameters. As set forth above, it is at least obvious to store the measured parameters.

As in claims 20-24, it appears that these are known manners of operating the controlling the etching and measuring device, and appears to be a part of the material the specification treats as so well-known that no particular disclosure needs be set forth in the specification.

4. Several of the claims (independent claims 8, 12, and 13, and dependent claim 5, for example), claim broadly that the wafer is partitioned into a plurality of portions (or similar language in other claims). The instant specification discloses that “each portion is individually regulated and individually controlled by the processor 814 via the etch controller 818 ...” (instant specification, page 14, lines 1-2). This appears to go beyond the general known use of an in-situ measuring device to make real-time measurements to control the etching as taught by the art of record, and it does not appear that the instant specification presents this disclosed partitioning and individual control of a plurality of individual portions as prior art material which is sufficiently well-known that mere mention is sufficient for full disclosure. Thus this disclosed material appears to be allowable, although, as set forth above, it appears not to be claimed in a manner that actually distinguishes it from known general use of in-situ measurements for control of the etching. Claims that are more specifically directed to this material, with a plurality of portions (rather than, for example, “one or more”) that are, as disclosed (but not now claimed), “individually regulated and individually controlled” would be allowable.

5. The appeal brief filed 22 August 2005 argues on page 6 that the final rejection “erroneously asserted” that the previously applied Moslehi reference shows the in-situ use of an optical measurement device for process control. This allegation is so clearly false that it cannot possibly be that the Moslehi reference has been understood. See, for example, column 5, lines 60-62 (“The existing commercial processing equipment usually lack suitable in-situ sensors for real-time process control and equipment diagnostics applications”), column 6, lines 43-46 (“the real-time in-situ sensors 26 are

employed for important tasks including ... real-time feedback control 30, and process/equipment diagnosis and prognosis 36.”), column 6, lines 65-67 (“the tasks of in-situ dielectric thickness measurement may either be performed in real time (for real-time rate control)”), and column 8, lines 50-52 (“This type of factory relies on intelligent real-time process control based on extensive use of in-situ sensors ...”). Moslehi discusses optical sensors (abstract, lines 7 *et seqq*: “Opto-electronic control box (214) includes circuitry for measuring the amounts of laser powers coherently reflected from and transmitted through the semiconductor wafer (124) surface and the amounts of electromagnetic powers scatter reflected from and transmitted through the semiconductor wafer (124) surface. Specular, scattered, and total reflectance and transmittance as well as surface roughness values for semiconductor wafer (124) are determined based on measurements of coherent and scatter reflected and transmitted laser powers”). Moslehi mentions etch processes, and clearly intends, by any fair reading, to have the various controls (30, 32 in figure 1, for example), apply to etch processes. There can be no doubt that the Moslehi reference knows of, presents, shows and teaches the in-situ use of an optical measurement device for process control in processing tools. Thus there can also be no doubt that the allegation to the contrary demonstrates a profound misunderstanding of that reference.

The appeal brief, in the sentence bridging pages 6 and 7, argues that Moslehi “is silent with regard to the claimed limitations of in-situ regulation of an etch process ... comprising one or more etching components operative to etch at least one aspect of a multi-sloped feature on a wafer and an etch component controller for controlling the one or more etching components” [emphasis omitted]. Read literally enough, that

statement is true in that the Moslehi reference cannot be applied *by itself* under 35 USC 102 or under 35 USC 103. However, it was not so applied, so read that literally the statement would be irrelevant and would thus be, if that were the intended reading, non-responsive as it is directed to a rejection that simply has not been made. Assuming that this statement was intended to be responsive and to address rejections that have actually been made, then the statement cannot have been intended to be read that literally. As the rejection does not present the Moslehi reference as teaching, or by itself suggesting, the use of optical measuring instruments to measure multi-sloped features, the sentence, if it was intended to be relevant and to be responsive, must have been intended to be read “is silent with regard to the claimed limitations of in-situ regulation of an etch process ... comprising one or more etching components operative to etch at least one aspect of a ... feature on a wafer and an etch component controller for controlling the one or more etching components”. As set forth above, this the Moslehi et al reference clearly does teach. So again, there is a clear misunderstanding of that reference.

6. It is, as noted above, clearly not a useful exercise to send to appeal a case in which the arguments are so clearly based upon such a deep misunderstanding of the reference, particularly, as noted above, when there is a real possibility of allowable subject matter. In an attempt to advance the prosecution, the rejection has been redrafted. The Mozumder et al reference shows, in figure 1, an in-situ sensor (18) attached to a semiconductor processing unit (20) with measurement being used to adjust the processing unit. Clearly, this reference is not “silent with regard to the claimed

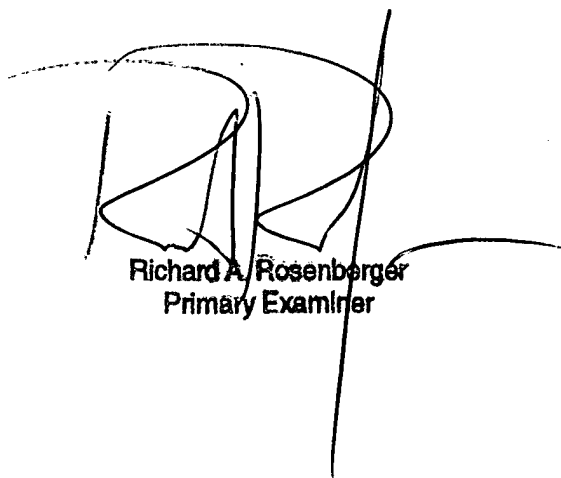
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limitations of in-situ regulation of an etch process ... comprising one or more etching components operative to etch at least one aspect of a ... feature on a wafer and an etch component controller for controlling the one or more etching components”

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Richard A Rosenberger whose telephone number is (571) 272-2428. The examiner can normally be reached on Monday through Friday during the hours of 8:00-4:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Gregory J. Toatley, Jr. can be reached on (571) 272-2800 ext. 77. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

R. A. Rosenberger
28 October 2005



Richard A. Rosenberger
Primary Examiner